The Carolina Engineer

SCHOOL OF ENGINEERING
University of North Carolina

MARCH, 1933

VOLUME I NUMBER 1

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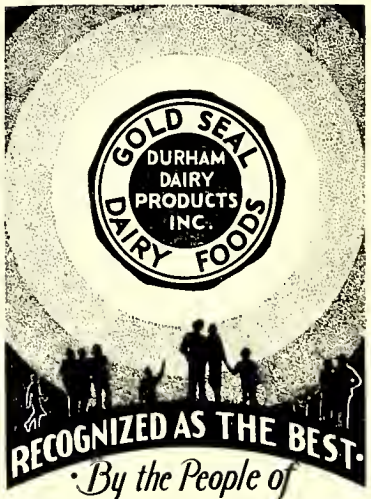

By the People of
Durham and Chapel Hill

The Carolina Engineer

The Professional Journal of the School of Engineering

University of North Carolina

VOLUME I MARCH, 1933 NUMBER 1

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E·D·I·T·O·R·I·A·L

G. W. GORHAM, JR. *Editor*

A STEP AHEAD

The inauguration of a professional journal by the students in the School of Engineering of the University of North Carolina at Chapel Hill is distinctly a progressive step in engineering education in the state. Until now the students in the School of Engineering have had little opportunity of making any contribution to the field of published information. But with the advent of a journal of their own, the students have an opportunity for publishing their work, which is limited only by the necessarily limited size of the publication. THE CAROLINA ENGINEER regrets that it does not have adequate facilities for printing every article submitted. But since the amount of material that can be included in any journal is limited by numerous factors, the greatest factor being the financing of the publication, only those articles which in competition with others show outstanding qualities can be included. Still this seeming disadvantage may be a very real advantage, in that it will stimulate competition among the students and act as a driving force to bring out the best that each man can produce.

Engineers must of necessity be men who can express their ideas in a logical and concise manner both in writing and in speech. Information which is to be kept for future reference is always put into writing; and the usefulness of such information depends almost entirely on the way in which it is organized and presented. A large quantity of invaluable information is continually being stored in the great warehouses of the technical journals and publications. The engineer who can prepare his ideas for the technical press has an advantage over other men in his field, which can be measured directly in terms of dollars, as well as in terms of personal satisfaction.

Only through continued practice can the young engineer learn the best way of presenting his ideas. This practice is furnished to the students, the engineers of tomorrow, by their own publications. Since the senior technical journals are already crowded with work of more mature minds, very little space can be devoted to the contributions of the students. But through the medium of a journal which they create and carry on themselves, the students are able to acquire that practice in organizing and presenting their ideas which will prove so essential in their later life.

The student journal is undeniably a step ahead in engineering education. Only a minority of the engineering colleges of the country have taken this step; but the idea is growing and the students and the men in the profession are lending their support. This school is proud of its progressive policy; and the CAROLINA ENGINEER is proud to assist the school and the progress of engineering education as it makes the step ahead.

TO WHOM IT MAY CONCERN

It is only fitting that in the first issue of the CAROLINA ENGINEER the general policy and plan of organization of the publication be made public. There is nothing in the organization of the publication that will or should be kept secret. It is with this thought in mind that the policy of the journal is now printed in this issue.

Foremost in the policy of the CAROLINA ENGINEER is the idea of democracy. It is a paper created and controlled by the *students* of the School of Engineering; and as such it will be operated in accordance with the desires of the students. The major positions on the staff are filled by popular vote of the students. The editor and the business manager are elected by the students from all the four departments of the school. Each of the four associate editors is elected by the students in his department. The remainder of the men on the staff are selected by the elected men from those students who show a desire to assist in the work. It will always be the goal of the men on the staff to follow as closely as possible the wishes of the students as a whole.

It has often been stated that student publications are controlled by faculty interests. This shall not be true in the case of the CAROLINA ENGINEER. This publication is financed and controlled exclusively by the students. Of course the advice and criticism of members of the faculty will always be invited and appreciated by the staff and by the students. But such advice or criticism shall never take the form of censorship. There has been no indication of any desire for control by the faculty. This statement is made simply to forestall any ideas that the journal is

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THE CAROLINA ENGINEER

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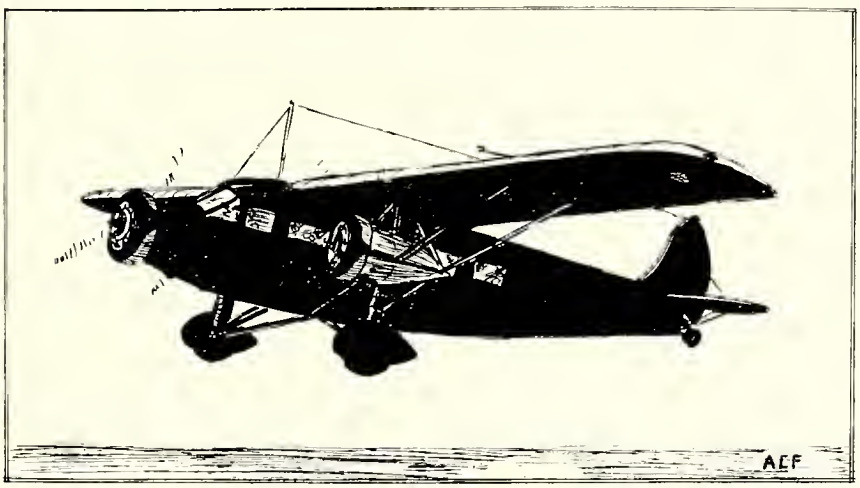
The Application of Radio to Aircraft Operations

By A. C. Furchgott, Jr.

THE USE of radio to direct and give information to planes in flight has increased to such an extent in the past five years, that there is no doubt of the important part it will play in future aviation. Radio will eventually give to commercial aviation the same safety and regularity of service that electric signals and instruments give to large railroad companies today.



Today radio serves the pilot of a plane in flight in two different ways. First, by the radio range beam or beacon he is constantly told if he is on his course; and second, by radio communication he is advised of the weather conditions and other facts he should know. Radio range beacons and telephone broadcasting stations to aid pilots in flight have been installed from coast to coast in the United States by the Department of Commerce and private air transport operators.

The use of radio in military planes will not be taken up in this paper because of the unnecessary length that it would require.

The radio range beacon was first brought to public attention in 1927 when it was used by Lieut. Maitland in his flight from San Francisco to Hawaii. Beacons have now been in use for the past five and one-half years, and have proven to be of great value to aviators. The regular installation for the use of the beam includes both audible and visual reception of the signals. The first beacons were of the audible or aural type; the visual type was developed later. Of course, to receive signals it is necessary to have a receiving set and an aerial on the plane. Although the aerial mast on an airplane is very unsightly, it is necessary for the reception of signals when the plane is on the ground or in the air.

The aural type beacon is most generally used today. This type sends signals through earphones to the pilot which indicates to him whether he is on or off the course. When the plane is exactly on the beam or airway the pilot hears a long dash broken periodically; whereas if he is to one side of it he hears a dash dot in his earphones, and if he is to the other side he hears a dot dash. The dot dash and dash dot signals are transmitted in such a relation that they combine to form a long dash when the plane is on its course. Of course the pilot should have a map giving the relation of the signals broadcast.

The action of the visual receiver is somewhat similar to that of the aural, except that instead of it being necessary for the pilot to listen for signals in the earphones, there is a small indicator on the dash board which gives the same information. The means of indication of the visual type is either a center-zero meter or a reed box. When the plane is flying directly on its course the center-zero needle is on dead center. If the plane goes off its course, the needle shifts off also in the same direction as the plane. The reed box differs slightly from the center-zero meter. In place of a needle pointer it consists of two metal reeds, tuned mechanically to 65 and 86 2-3 cycles per second respectively. These two reeds are driven by electro magnets connected to the output of the radio receiver, and are painted with a white luminous material to make them conspicuous. When the plane is flying on the beacon, both reeds vibrate the same amount; whereas one vibrates more than the other if the plane is off the beam. The equipment is made so the flier turns the plane toward the reed vibrating with lesser amplitude to get back on the beam or course.

Many people think the apparatus for transmitting the beam is very complicated, but in reality it is very simple. At each transmitting station are two large loop antennas. Each loop is made up of one turn and is approximately three

hundred feet long and sixty feet high. These two loops cross each other in the center at right angles. The whole beam system is based on the fact that a loop antenna has the characteristic of transmitting signals directionally, giving a figure eight field pattern. By putting the two loops at right angles the resultant field pattern is made up of two figure eights at right angles. The apparatus is adjusted so the transmitter broadcasts a dash dot on one loop and a dot dash signal on the other. When the pilot receiving these signals is halfway between the geometric planes of the two loops, that is, when he is flying a course at an angle of 45 degrees to either of the antenna (angle measured from intersection of two loops), he will receive both the dash dot and dot dash signals with equal strength. These signals combine to form the long dash in the aural type. It can be seen from this that every transmitter produces four beams around itself at right angles to each other. By use of additional apparatus the 90 degree relation between the courses can be altered, and all four courses can be directed to suit the needs.

The visual beacon transmitter differs from the aural only in the fact that instead of sending signals it sends radio energy. One of the loops is supplied with radio energy modulated at a 65-cycle rate while the other is modulated at 86 2-3 cycles. When both reeds vibrate with equal amplitude the pilot knows he is flying in the beam. The width of these radio beams is approximately one and one-half degrees.

In the past months a few men have experimented with the radio beam as a guide in assisting planes to make blind landings, that is, to assist planes to make landings without the pilot seeing the ground. The most recent developments resulting from this experimentation are the portable radio beam, the airport boundary or marker beam, and the landing beam, the latter of which is far the most important.

The portable radio beacon is similar to the large beams; the only difference is that it has a much shorter range. Flyers are easily guided between cities by the large beacons in bad flying weather; but it is sometimes difficult to locate the airport, find the direction of the wind, and land. The portable beacon is adjusted so that one of its courses intersects the main beam course. The portable beacon is usually placed about one mile on the windward side of an airport. This makes a radio beam about seventy-five feet across the field. The pilot follows the main beam until he hits the portable beam. He then flies this beam to the field. When he crosses the field boundary he is informed by a buzz in his earphones (or a signal on the visual indicator) from a marker beam. The plane should be equipped with a good altimeter to give its approximate height over the ground. Immediately after passing over the boundary marker the pilot eases his plane down to approximately thirty feet off the ground (A good altimeter will read accurately up to 25 feet. But as it reads only the height above sea level, it is necessary for the pilot to know the height above sea level of the airport he is landing on). A short time after the plane passes the boundary marker beam another marker signal informs him that he is in a safe landing area. If he is in a fair landing position, according to his altimeter reading, he glides his plane in at a flat angle. If he is not in position when he receives the second marker beam, he turns his plane and tries again.

The airport boundary or marker beam is used entirely at the present time to mark the edges and landing areas of airports. It has recently been suggested that a small beacon of this type be placed on each of the airway lights, which are spaced ten miles apart on airways developed by the Department of Commerce and private transport companies. A distinctive signal from each beacon would then inform the pilot exactly where he was. This suggestion will probably be put into practice in the near future.

The landing beam, on which much experimentation has been carried out recently, will greatly increase the margin of safety when landing blind. The pilot flies on the large radio beam until he is over the field boundary marker. He then circles and picks up the landing beam. This beam differs from the others in that it sends its signals out at an angle to the ground and in the wind direction at that moment. The angle at which the signals are sent out is on a seven-to-one slant (about nine degrees) which corresponds to the gliding angles of most airplanes. The flier after picking up the landing beacon has only to put his plane in the correct glide to keep on the beam. He thus rides the beam to the ground and makes a safe landing. This type of beam is far better than the portable beam which actually gives the pilot only the wind direction. The landing beam is newer and when perfected will probably take the place of the portable beam.

Modern planes are not only equipped with radio beam receivers but also with two-way communication radio sets. The first successful two-way communication between an airplane and a ground crew was demonstrated on the White House grounds in Washington, D. C. in 1919. Some radio beacons recently developed permit simultaneous transmission of beam signals and

(Continued on page sixteen)

Highway Location: General Considerations

By Prof. T. F. Hickerson

Good roads are intended primarily to supply means of communication and transportation from place to place with a minimum of time and effort. The highest aim of road making, it has been said, is "endeavoring to help make smooth the paths of humanity." One of the fundamental operations in road building is the *location survey*, which becomes, or should become, through construction a permanent feature.

Among the characteristic features of a *bad road* may be mentioned *steep grades, abrupt curves, dangerous exposure* (to intersecting traffic, snow drifts, etc.), *insufficient drainage*, and *uneven surfaces*. The first four of these obstacles to traffic are of a *permanent nature* due to a *faulty location*, which might have been obviated with an unrestricted application of engineering principles. Too many locations in the past have followed an old road or the line of least resistance; which must sooner or later be abandoned as unsafe and unsatisfactory for the traffic of today and tomorrow. Obviously, future changes in location, unless the old road can be used advantageously for local purposes, are attendant with losses of right of way, roadbed, surfacing, and structures as well as a depreciation in the values of property developments along the abandoned route. The ideal procedure in any road-building program is to make sure that the location is the best possible, so that what is done is permanent and an integral part of any future improvement.

The engineer is faced with the dual responsibility of selecting a location which will become and remain a major route of highway transportation and of satisfying public opinion as to whether the initial expenditure is economically justifiable. Under all circumstances, he should so execute his work that it may be successfully defended from future criticism.

The greatest skill and care should be exercised to see that the located center line, with respect to appearance as well as usefulness, will be the most consistent location possible. The newly selected line forms the basis of a high-priced improvement to serve intense modern traffic that may in the future require a pavement two or more times the present contemplated width.

The modern paved highway is worthy of its right-of-way.

The primary technical considerations in road location, whether it be a revision of an existing road or the layout of an entirely new route, are *alignment* and *grade*. These considerations must be reconciled with many other factors, as follows:

Funds available: Comparative initial cost and annual interest, maintenance and operating expenses.

Purpose of the road in question and its relation to the highway system.

Classification of the road as to standards of width, alignment, and grade and type of surface and improvement.

Restrictions on Location: strategic points; service to the towns and cities; local sentiment.

General public welfare.

Traffic count; present and probable future traffic conditions.

Right-of-way privileges.

Topographical geological features of the country.

Best stream and ridge crossings.

Flood areas; drainage.

Safety, ease, and economy of travel.

Railroad grade separations.

Location and grade of intersecting roads.

Visibility.

The ultimate plan.

Climatic conditions—exposure to the sun and snow control in areas of heavy snow fall.

Aesthetic considerations.

The influence that the foregoing factors may exert justifiably in road location will now be treated in some detail.

Alignment. In establishing the line of highway between objective points, *directness* has always been a major factor subject to the limitations of avoiding excessive grades. With the advent of fast-moving, high-powered automobile vehicles, composed of passenger cars, large busses and heavy commercial trucks, improvements in the alignment are increasingly desirable, not only as an element of economy in reducing distance, but as an element of safety against accidents. The alignment should be made as safe as possible considering the funds available, even at the expense of a steeper grade (up to a reasonable maximum). Short curves and abrupt turns are dangerous hazards that should be avoided, if possible; particularly so, on steep grades, at the foot of long hills, and between long tangents.

There should be a logical reason for every curve. A combination of maximum curvature and grade should be avoided; and hence all grades on curves in mountainous regions should be compensated.

Hidden reverse curvature or a combination of

horizontal curve with a summit vertical curve are an unsafe combination and should be avoided.

Curves in the same direction with a short tangent between them, commonly known as broken-back curves are objectionable from the standpoint of appearance and they may be a source of danger. Usually it is feasible to combine them into a compound curve; but in this event, the difference between the two branches of the curve should not exceed 5 degrees.

Curved approaches to a bridge are objectionable. They may often be avoided by placing the structure on a slight skew.

Every effort should be made to secure flatter curves, even down to 30 min. curves; although a sharper degree of curve is adopted as a maximum. All curves are greatly improved when connected to the tangents with long transition spirals; and curves sharper than 1 degree should be super-elevated. Pavements on curves sharper than 4 degrees should be widened.

In a 60 degree turn, the distance saved by using a 1 degree curve instead of a 6 degree curve is 513 feet; and by applying spiral approaches to the 1 degree curve, there is a further saving in distance of 27.6 feet.

A sudden change from one standard of alignment to a lower standard is a source of danger and responsible for numerous accidents. A few isolated sharp curves within a zone of much better alignment, or a sharp curve at the end of a long tangent, should be improved at the earliest moment.

To avoid the appearance of a kink in alignment, curves should never be less than 300 feet in length.

As a conclusion to the discussion on alignment, the following axiom is offered (quoting W. W. Crosby), "What looks right may be wrong, but what looks wrong cannot be right."

Grades. As a general rule, grades in excess of 5 per cent should be avoided, if possible, for two reasons: (1) Difficulty of ascent and increased danger of descent; and (2) Possible erosion of the road surface, shoulders or ditches. But it is better to use a steeper grade (up to 7 per cent), for a short distance, if bad alignment is obviated thereby.

From the standpoint of ascent, the modern high-powered car can climb readily short grades as steep as 8 per cent; but even so, continuous grades of more than 5 to 6 per cent are objectionable. To descend grades steeper than 7 per cent may at times subject the motorist to great hazards.

The matter of surface erosion is vital for soil roads, but less important for paved surfaces (including shoulders and ditches). The minimum grade should be sufficient for longitudinal drainage.

By the use of lower maximum grades, more uniform speed of car operation can be maintained and greater reserve power will be available for retarding and accelerating when passing slow vehicles or in emergency. Heavy commercial vehicles find easy grades better adapted to their use.

On long grades it is preferable to place the steepest grades at the bottom and lighten the grades near the top of the ascent, or to break the sustained grade by short intervals of lighter grade, than to lay a uniform sustained grade that might be only slightly below allowable maximum.

Funds. Highways are usually financed either by (1) bond issues or (2) "pay-as-you-go" plan.

The bonding plan requires a definite program in advance. This plan is best when the program is just beginning and before any great part of the system has been completed. It permits quick construction of projects large enough to secure the advantage of big contracts at low prices; but in carrying out a mass production plan, there has been a tendency to cut short the time needed for a thorough study of each location problem.

The "pay-as-you-go" plan should be used when the construction of the highway system is more advanced or is nearing completion. It may be successfully used if annual revenues are plentiful and it should be used in any case where the present bonded indebtedness is so heavy as to have affected adversely the public credit of the State or county.

Bonds. The form of bonds in general use are the *term*, *serial* and *annuity*. Term bonds mature after definite periods and require a sinking fund. Serial bonds are retired annually or at other periods, a fixed portion of the issue being retired at each maturity date. The annuity is similar to the serial, but the retirement plus interest is maintained at a constant figure.

The serial bond is the cheapest and is the most popular for highway financing. This type is particularly adapted for financing operations which by their very nature involve a depreciation of property. A highway is in part a depreciating property.

Comparative Costs. Alternate locations may be studied in terms of their comparative capitalized cost (or annual cost). The capitalized cost of a highway is that sum which is sufficient to pay the initial cost of construction and provide for future maintenance and operation and renewals forever for those elements of the investment which are not permanent.

The *annual cost* is the interest on the capital-

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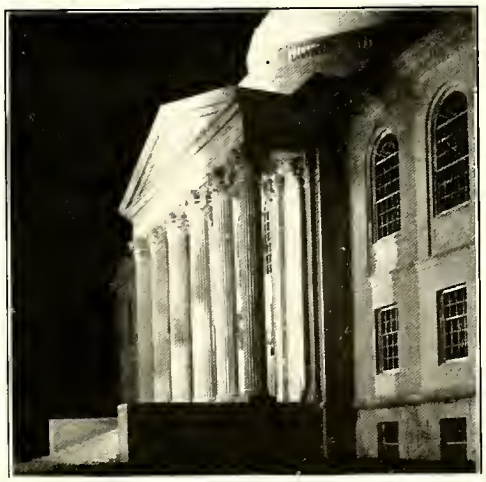
Lighting for the Future

By J. E. HUNTER

Light is one of the dominating agencies in life and progress, for it is essential to our most important and educative sense, vision. For this reason the field of lighting is boundless in scope.. Up to the present comparatively little has been done in the field of artificial lighting, yet, when it is remembered how young it really is, it would seem as though considerable progress has been made. Up to fifty years ago, when the sun went down, civilization had to depend for its light on gas and oil lamps, which, in addition to producing very inadequate illumination, were both inconvenient and dangerous. Edison at that time invented his incandescent lamp; his dream was to produce an artificial source of light that would be safe, convenient, and instantaneous. In that he succeeded, but there was still much to be done, for the carbon filament in his lamp did not give a strong enough light to be of any great utility. Soon the carbon filament was replaced by coiled tungsten wire, which, on account of its high melting-point, produced a much brighter light. Since that time very few improvements have been made, such as filling the bulb with inactive gas instead of exhausting the air from it, changing its shape to allow for more efficient cooling, and using other high melting-point alloys in the filament.

It is, of course impossible to predict what development the future will bring in the field of



illumination other than to point out the lines along which that development is progressing at the present. That modern development seems to be for three general purposes, utility, beauty, and health.

The principal purpose of artificial light is without a doubt utilitarian, or, in other words, for seeing. The trend of interior lighting is toward more powerful and better diffused light. Everyone knows that it does not hurt the eyes to look into a burning automobile headlight in the daylight, while a distinctly unpleasant glare is experienced from the same lamp at night. In the latter case the light appears brilliant because it is contrasted by the dark background, but when the background is light, there is no unpleasant sensation. Therefore illuminating engineers believe that it is impossible to have too much light; the difficulty lies in properly diffusing the light to prevent glare.

Psychologists have proved that the greater amount of light we have on a subject, the faster we see. This fact is illustrated by means of a very interesting experiment. A circular disc, about eight inches in diameter with heavy black radial lines, is rotated about its center at constant speed in poor light. When a bright light is turned on the disc, it appears to slow down greatly. Since the disc is rotating at constant speed, it is only natural to conclude that our vision is accelerated by better lighting.

Stronger and better diffused lighting is being produced in many ways at the present. The strength is, of course, obtained by the use of larger bulbs. For the past few years the size of bulbs has increased greatly until now any size may be obtained up to 50,000 watts. This new 50,000-watt bulb gives off the same amount of light as 1,800,000 ordinary candles. The light is diffused by means of frosted bulbs, shades, lamps, and reflectors. One of the best methods that have been found to diffuse light is indirect lighting.

Much attention is being paid by illuminating engineers to the subject of direct and indirect lighting, especially for commercial purposes. They believe that physical activity calls for direct lighting, and mental activity, indirect. In a "five and ten cent" store, where the customer is interested in making his purchases quickly, a strong direct component of light should be used. In a drafting office, where mental and physical activity are about equally mixed, both direct and indirect components are used. Where mental activity is of primary importance, as an executive office, a very strong indirect component is necessary.

Safety lighting is of growing importance at the present time, especially in the field of aviation. Much work is being done on lighting facilities for airports, for which the Interstate Commerce Commission has drawn up a set of specifications. It recommends a large beacon light rotating at the correct speed to attract the aviator's

eye most quickly (about six revolutions per minute), a signal beacon for the purpose of telling him what airport he is approaching, flood-lights so located as to illuminate the runway, small border lights to indicate the size and shape of the field, and red lights on all overhead wires and other obstructions.

At a recent convention of the Illuminating Engineering Society, in Pittsburg, Captain Eaton, commandant of Roger's Field, demonstrated a new development in aviation lighting equipment. He flew over the city at night guided by a searchlight, recently developed by the Westinghouse Electric and Manufacturing Company. This searchlight is one of the smallest in existence, weighing only 50 pounds and having a lense 18 inches in diameter. It employs a 250-watt lamp, designed to be operated from a storage battery. So powerful a beam is produced that a newspaper may be read at a distance of five miles. This searchlight will undoubtedly make night flying much safer than it has ever been before.

Another phase of safety lighting was brought to the notice of the public in the past year. The new Italian liner, *Conte Grande*, was equipped with six 250-watt flood lights focused on the smokestacks, which are painted with a light-reflecting color. This equipment serves a twofold purpose, to light up her deck and, more important, to make her visible to other ships in a fog. This new development in lighting should do much to prevent wrecks at sea.

The second purpose of lighting, beauty, has been developed only slightly. Illuminating engineers are only beginning to realize the great variety of beautiful effects that can be obtained by color and shadow combinations. These possibilities were well illustrated by Roy A. Palmer in a lecture given at the A. I. E. E. meeting in Chapel Hill, on April 5, 1932. For the purpose of illustration he used a small section of a cove-light, painted a light diffusing color. In the section were several hollow cylinders inside of each of which were red, white, green, and blue bulbs, the same colors being used around the outside of the cylinders. By varying the intensities and colors of the lights inside and outside the cylinders, he was able to get a great variety of color and shadow effects. Every color in the spectrum was produced from the three primary colors, and the shadowy effects were made possible by the cylinders.

In the home the utilitarian purpose of lighting is fast becoming secondary in importance to the beautifying. Home-builders are beginning to realize that lighting is a subject that requires careful consideration. Too often a person buying fixtures for the home is sold the fixtures themselves rather than the lighting effect, which he really expects to get. The lighting equipment can be made flexible enough to blend in with a great variety of moods, especially in the living room by careful selection and location of fixtures, lamps, and wall-brackets. Two new pieces of equipment that will do much to produce a variety of effects are a lamp with a strong upward component of light and small colored lights to be placed at various points about the room.

On the stage the possibilities for beautiful effects are made practically unlimited by the use of flood-lights, spot-lights, border-lights, and similar equipment. A very unusual illustration of these possibilities was seen in a recent production in New York. The scene in the second act was an exterior with a mountainous background. A forest fire started far in the background and gradually advanced until a large fir tree at left-center stage burst into flames and finally fell over a cabin which was up-left stage. The whole effect was realistically complete, including the illusion of leaping flames and rolling clouds of smoke. This effect was accomplished with 125 flood-lights; in front of these lights moving screens were used on which were painted the red flames and the gray smoke. The whole apparatus was automatically controlled by clock-work.

A great amount of attention is being paid at the present time to exterior lighting of buildings. The accompanying picture of the University Library illustrates some of the beautiful effects that can be produced in this manner. From the picture it will be noted that much beauty has been gained by the utilization of shadows instead of the usual pure flood-lighting. This practice is doing much to beautify our American cities and will undoubtedly be continued and developed in the future.

The third and newest purpose of lighting is for health. Scientists have found that the health-giving properties of sunlight are due to the ultra-violet rays which have very short wave-lengths and are not visible. Although these rays are not produced by ordinary artificial lights, it has been known for some time that they are produced by mercury vapor and carbon-arc lights. Until recently it was not possible to make a usable light that would give off these rays because ordinary glass will neither reflect nor refract ultra-violet. Lately it has been found that the rays are reflected by polished aluminum and chromium reflectors and refracted by a special quartz glass.

The first health-lamps, which were unshielded carbon-arcs, were both inconvenient and dangerous. They were inconvenient because it was necessary to use bulky resistors and to adjust the

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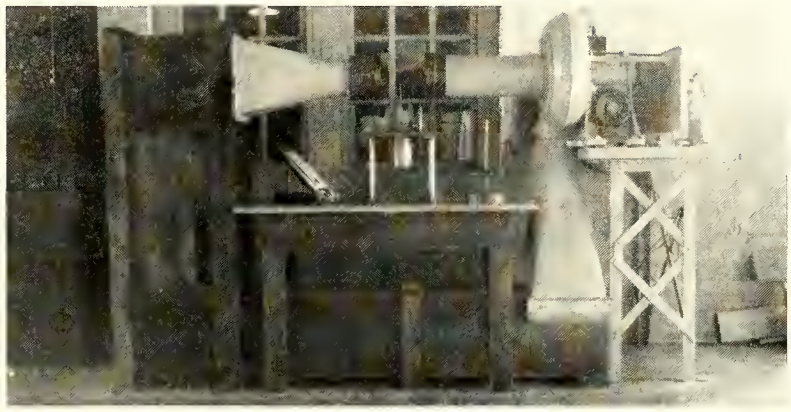
The New Wind Tunnel in the Mechanical Engineering Labratory

By E. L. MIDGETT

For the past four years the Mechanical Engineering Department of the Engineering School has offered an option in aeronautical engineering to those students who profess a preference for that type of training over the conventional studies in power plant work. Until this term the major portion of the aeronautic studies have had to be along the purely theoretical lines of aerodynamics as outlined in text books and the Reports of the National Advisory Committee on Aeronautics. It has been possible to augment these theoretical studies in only a very few instances by experimental practice. Naturally this lack of experimental work has handicapped the students in obtaining a clear understanding of the subjects being studied. Throughout these four years every possible effort has been made to secure for the Mechanical Engineering Laboratories a wind tunnel that could be utilized in properly instructing students of aeronautics in the fundamental characteristics relative to the action of the forces on a body moving in air at high velocities. These efforts were rewarded this past fall term when $200 was granted to the Department for the purpose of buying materials for the construction of a 6 inch, open throat wind tunnel of the closed return type.



This type of tunnel was selected because of its readily accessable test section. The open throat test section affords the experimentor a better chance to view what is taking place while a test is in progress. Also the closed return for the air eliminates, to a large extent, the effect that changing air conditions of the test room might have on the action of the air in the tunnel. The details of the design of this tunnel, and its actual construction have been carried through by Prof. Neil P. Bailey, assisted by this writer.

The included picture gives a full view of the tunnel along with part of the instruments that are used in actual test work. The picture shows that the blower takes in the air through a circular cylinder, and discharges it into a tube that changes the cross-section of the air stream till it enters the square, wood constructed, portion of the return channel. Through this channel the air passes to the reducing, discharge spout and the test section to start its circuit all over again. The return section has three 90 degree turns in it, and guide vanes had to be placed in these corners to prevent the air piling up; which would directly cause an uneven distribution of the air velocity across the throat stream. Checks on the velocity distribution across the throat stream have conclusively proven that these vanes are functioning properly. The air is propelled through the tunnel by a Sturdivant Blower which is powered by a 2hp. direct current electric motor. Thistype of motor was chosen because of its ease of speed control over large ranges of speed.

The blower is designed to operate under an air pressure equal to 9 inches of water. Actually the friction pressure drop around the tunnel is all that the blower has to overcome and that is only approximately equivalent to 1 inch of water. Still this blower was chosen because the quantity of air that it will handle per minute varies almost directly with the speed of the blower. This is a very necessary characteristic if good control of the air velocity is to be had. The capacity of the blower is such that it forces the air through the tunnel at about 100 m. p. h. when operating at high speed.

A measure of the air speed is obtained from a combination pensometer and pitot tube which when placed in the air stream parallel to the flow, converts the velocity into pressure head which is measured by an inclined manometer tube. Both of these devices have been designed and built in the laboratory shop to fit the needs of this particular tunnel.

The speed of rotation of the blower is indicated by a liquid tachometer. The operation of a liquid tachometer depends on the principle of Physics which states that when a quantity of

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Activities of the Engineering Societies

A. I. Ch. E.

By F. H. LENTZ

The local chapter of the American Institute of Chemical Engineers has been holding meetings on alternate Tuesday nights during the quarter in Graham Memorial. The programs have been directed along many different lines, the speakers coming from different departments of the University.

Among its outside activities, the most important one was "Chemical Engineering Day" at the University on Dec. 5, 1932. The main speaker for the day was Dr. Webster N. Jones of the Carnegie Institute of Technology, formerly with the Goodrich Rubber Company in Akron, Ohio. The subject for Dr. Jones' feature address was "Rubber." Another of the guests of honor was Dr. A. H. White, head of the Department of Chemical Engineering at the University of Michigan and former president of the American Institute of Chemical Engineers. A banquet was given in honor of the guests in the evening.

This year the local student chapter of the Institute inaugurated the plan of awarding a scholarship each year to a Junior or Senior who has shown himself to be worthy of it. The recipient of the scholarship is chosen on the basis of scholarship, personality, and need of the applicant. The first award to be given went to a Senior, L. C. Suprenant. This is to be made an annual award by the chapter in an attempt to raise the scholastic average of the students of Chemical Engineering at the University.

A. S. C. E.

By FRED C. CAIN

In May 1932 the following students were elected to the following offices of the local chapter:

J. F. Geiger	President
A. C. Brown	Vice President
W. A. Burch	Secretary
R. E. Froneberger	Treasurer

The chapter has been conducted under their supervision this school year.

Meetings of the chapter have been held twice a month. At these meetings lectures have been given by members of the faculty, students, and visiting engineers.

At the beginning of the year Mr. Wm. M. Piatt, Consulting Engineer of Durham, N. C. and contact man for the local chapter, lectured on "Civil Engineering as a Profession" and discussed the work of the chapter for the present nine months.

Later, two lectures, illustrated by slides from the A. S. C. E. office in New York, were given by student members of the local chapter. The first lecture was given by A. C. Brown on the "Westchester Park System of New York." The other was given by R. E. Froneberger on "The Cascade Tunnel"—a railroad tunnel in Oregon.

Mr. L. R. Ames, Maintenance Engineer of the State Highway Commission, visited the chapter and explained the organization of the S. H. C. and some of its work.

Professor T. F. Hickerson, Professor of Civil Engineering in the University and a member of A. S. C. E., gave an account of an A. S. C. E. meeting in New York attended by representatives of the local chapter during the winter quarter of school.

Other activities of the chapter were composed of the regular business and the work done in cooperation with the other three engineering societies in planning and conducting the annual Engineer's Ball.

A. S. M. E.

By P. R. HAYES

Since the start, last Fall, of its second year of direct affiliation with the national society, the local student chapter of the American Society of Mechanical Engineers has had several meetings. The chief features of these meetings were the showing of two films loaned to us by the army air corps; the submitting of two papers: one by J. A. MacLean on "Racing Airplanes," the other by George W. Gorham, Jr., on "Recent Developments in the Automotive Industry"; and a lecture by Dr. G. R. MacCarthy, professor of meteorology in the Geology department, on various types of storms, their causes and characteristics, and methods of predicting them. At the first meeting of the scholastic year, Professor N. P. Bailey, the Society's Honorary Chairman, made an introductory address, for the benefit of new members, on the purposes of our group. He especially pointed out that ours is the only local student engineering chapter directly affiliated with a national society, and enumerated the particular advantages derived therefrom. At this meeting Mr. T. B. Stroup was introduced as our English advisor, and he expressed a desire to help us in every way possible. Most of the business transacted at these meetings concerned the CAROLINA ENGINEER and the Engineer's Ball.

Of especial interest is the news that the local chapter plans to send a delegate to the national A. S. M. E. student convention at Birmingham, Alabama, March 31st—April 1st. All members of the chapter are entitled to enter competition

for the selection of the official delegate by submitting a paper on some subject relating to mechanical engineering. The writer of the best paper will be appointed the official delegate. More delegates will be sent if possible.

A. I. E. E.

By W. E. Davis, Jr.

Among the most outstanding activities of the student branch of the American Institute of Electrical Engineers during the fall and winter quarters was the inspection trip made by the senior class, January 27, to Charlotte.

Enroute to Charlotte, the class stopped first at Norwood, where the power plant of the Carolina Light and Power Company was inspected. Guides were furnished the class to explain the purpose and operation of the apparatus in the plant.

From Norwood, the class went to Charlotte, where the electrical equipment employed at the Southern Bell Telephone Company, radio station WBT, Lakewood sub-station, Mountain Island Hydroelectric plant, Mount Holly Mercury arc Rectifier station of the P & N Railway Co., and the Riverbend station of the Duke Power Company was inspected. At each of these plants, guides were also furnished the class to explain the use and method of operation of the equipment.

At the regular meetings, talks were offered by student and faculty members on a wide variety of subjects. At several of the meetings, refreshments were served.

J. D. McConnell, who graduated from the electrical department of the University in '31, gave a talk at the meeting Feb. 21. McConnell has a position as plant engineer at the Burlington Mills in Burlington.

Roy A. Palmer, illuminating engineer with the Southern Public Utilities Company gave an illustrated lecture on illumination, March 1.

TAU BETA PI

By J. A. MacLean, *President, Tau Beta Pi*

The North Carolina Beta chapter of Tau Beta Pi was founded at the School of Engineering of the University of North Carolina in 1928. The purpose of the organization is to mark in a fitting manner those who have conferred honor upon their Alma Mater by distinguished scholarship and exemplary character as undergraduates, or by their attainments as alumni; and to foster a spirit of liberal culture in the Engineering Schools of America. At present there are 62 chapters of the organization in engineering schools all over the United States.

The organization here started the current year with the following officers: President, J. A. MacLean; Vice-President, J. R. Marvin; Corresponding Secretary, T. R. Taylor; Recording Secretary, J. F. Geiger; Treasurer, E. L. Midgett; and Cataloger, J. E. Hunter. The annual fall tapping took place in October, at which time 4 seniors and 3 juniors were elected to membership. These new men were initiated on October 9, 1932. Following the initiation there was a formal banquet in honor of the new members.

In January of this year a luncheon was held in Graham Memorial at which G. W. Gorham, Jr., was awarded the prize for the best paper presented at the time of initiation. The title of the winning paper was "Mathematics in the Curriculum of the Engineering School."

On the night of February 3, preceding the Engineers' Ball, a formal banquet was held in honor of the ladies. At this banquet there were present about 30 people, including student and faculty members and their ladies.

It is planned to have luncheons every month for the remainder of the year. At these luncheons papers on topics of general interest to the members are read. The annual spring tapping and initiation will probably take place in April. At the close of the year officers will be elected to serve during next year.

LIGHTING FOR THE FUTURE

(Continued from page eight)

carbons at frequent intervals. Carbon-arcs produce a number of rays shorter than ultra-violet which are very dangerous to the eyes; in addition to this they are so rich in ultra-violet rays that there is considerable danger of over-dose, resulting in severe sunburn.

The newest addition to health lighting is the Mazda Sunlight lamp, in which the light is produced by a mercury vapor arc, started by the tungsten filament. The bulb itself is made of special quartz glass. This bulb has several advantages; its ultra-violet content is not strong enough to cause an over-dose, even after long exposure, and yet is sufficiently strong to produce the desired effect. It is entirely automatic and produces the same amount of visible light as a 200-watt bulb. Many illuminating engineers believe that ordinary lighting will soon be superceded by some form of sun-lamp similar to this one.

Judging from the present development in lighting, it seems plausible to say that the lighting of the future will be of greater intensity and better diffused, more attention will be given to the beautifying effect of light, and "sun lamps" will be used generally both in the home and place of business. Several well known illuminating engineers have even gone so far as to say that artificial lighting will eventually take the place of natural lighting.

EDITORIAL

(Continued from page two)

not a publication controlled exclusively by the students.

Selection of articles to be published in the CAROLINA ENGINEER will be based on the quality of the articles alone. Any article that is submitted for publication will be given careful consideration by the staff; and the best selected for insertion. An effort will be made to include in every issue articles from each of the departments of the school. Articles from faculty members or alumni will be considered for publication. But in no instance will such articles be included in quantities large enough to materially reduce the space devoted to the work of the students. The staff is of the opinion that papers from more experienced men will be of great value to the journal if inserted in the right ratio to the papers submitted by the students. However, it would be entirely unfair to the students to allow the work of outsiders to monopolize the space which is definitely student property.

All students in the School of Engineering may compete for space in the CAROLINA ENGINEER on an equal basis, the quality of the paper he submits. Underclassmen shall receive the same consideration as upperclassmen. The papers in this issue are composed almost entirely from the work of upperclassmen; but this is not a case of favoritism. It was caused by the fact that the underclassmen did not prepare and submit papers. The staff hopes that in the future the underclassmen will compete for space in the publication. Our outstanding rule is equality for all. Every man has an equal chance. Opportunity knocks on each man's door; and it knocks more than once.

CREDIT WHERE CREDIT IS DUE

Much of the credit for the organization of the CAROLINA ENGINEER goes to the three members of the Department of Engineering English, Dr. A. C. Howell, Mr. J. O. Bailey, and Mr. T. B. Stroup. Although these men have at no time been under any obligation to assist in the creation of a student publication, they have given freely their time and attention to the organizing of the plans for the journal. They have always been ready and willing to cooperate with the staff members and lend their advice and assistance. The students are glad to take this opportunity of expressing through the columns of their magazine their appreciation of the valuable help given by the gentlemen from the Engineering English Department.

The real beginning of the journal dates back several years to the time when the students in Dr. Howell's course in Advanced Technical Composition organized, with the help of Dr. Howell, a paper which they called the CAROLINA ENGINEER. Funds for the paper were limited; so it was published in mimeographed form. For several years the paper was carried on; and it received much favorable comment from those who had the opportunity of reading it. Then Dr. Howell was away from the University on leave; financial aid from the School of Engineering could no longer be received; the CAROLINA ENGINEER ceased operations indefinitely, but not before the worth of such a journal had been proved.

This issue of the CAROLINA ENGINEER marks the rebirth of the old journal of the English class. Enlarged, based on a more secure foundation, and dressed in better form, the CAROLINA ENGINEER still remembers its beginning in the simpler form. Credit is due to those who began the paper in the English course; and the students give that credit and their thanks to the originator of the first CAROLINA ENGINEER.

DON'T LOSE HOPE

With conditions as they are at present many students are inclined to look at the future through the eyes of the pessimist. Surely these men will see new hope in the statement made by Pres. A. A. Potter of the A. S. M. E. in the February issue of the *Student Branch Bulletin* of the A. S. M. E. Part of this statement is given here in the belief that it will be of great benefit to all who read it. Mr. Potter writes:

"During these days of readjustment there are many who are rather pessimistic about the future. Let me assure you that if you properly qualify yourselves to serve society as members of the engineering profession, you will have no reason to despair either of the future of our country or of the opportunities which will be afforded you. This country has passed through a number of depressions, and has always emerged stronger and better. It will also interest you to know that many of the most distinguished members of our profession began their careers in years of panic and distress. They attained success because they had unbounded courage, correct ethical conduct, high intelligence, unlimited adaptability, and tireless industry, as well as absolute faith in humanity, in the dignity of their calling, and in our country's future. Outstanding qualities of character and conduct, plus sane optimism and good mentality, will enable you to reach your goal in life."

HIGHWAY LOCATION: GENERAL CONSIDERATIONS

(Continued from page six)

ized sum. It includes annual interest on the first cost plus maintenance and operating costs plus a replacement fund.

Maintenance costs are for keeping the roadway in proper condition; while operating costs refer to the expenses encountered by the traveling public. The latter item may be only a rough estimate in any one case; but for purposes of comparison with alternative routes, it is more definite. The costs of future replacements are not accurately known, but they may not exceed the first cost if the old parts have scrap value.

Relatively speaking, the capitalized cost serves as a guide to the judgment in considering the merits of two or more routes.

Purpose of the Road. The primary use of a modern highway, generally speaking, is to provide means for vehicular transportation of the various classes of travel and commercial haulage from one common center to another, either local, State, or National. They should be established over the most direct route possible with the least gradient. The most direct route may be defined as a road with alignment free from curves that have dangerously short sight-distances based on the importance of the road and the speed limit involved; and the least gradient should be such that it will not retard materially the reasonable speed of present-day vehicles.

The foregoing requirements for line and grade may be dispensed with advantageously, to some extent, in cases of scenic development, when locating forest and park roads or other lanes of traffic promoted solely for pleasant landscape effect, recreation or educational travel.

Restrictions on Location. The general location of a highway project, or the route of which it is a part, is sometimes fixed by legislation to the extent that it must pass through one or more points. Within the limits established as controls the engineer should determine, as far as practicable, upon an economic location, considering at their relative weights both through and local traffic. Local sentiment may call for the diversion of the main line from its direct course in order to serve an intervening town or community. The engineer must wrestle with this problem and give due weight to all the factors involved. The relative cost of the direct line with a lateral spur and the indirect line through the town should be considered from the standpoint of construction, maintenance and operation.

The location and design of trunk-line highways into, through and around cities is a problem for the engineer that requires extensive study and investigation. A by-pass and local route serving both local and through traffic offer the ideal solution to be attained. Belt line highways with local connections may be the best plan for still larger cities. Each situation is a problem in itself, but the solution should always have the same object —the greatest possible service to all the users of the highways.

After a careful traffic study and analysis relative to arterial routes for traffic to and from the city and belt lines for traffic distribution, the city of Cleveland and its contiguous territory, with the cooperation of State and county authorities, have developed a plan for major road and street improvements for ten years ahead. They may therefore proceed with individual projects, knowing their final position in the broader plan.

Right-of-Way Privileges. The width of right-of-way needed depends on the future requirements of the road and also the means for its protection from encroachment and exploitation. Few states have adequate laws regarding right-of-way acquisition and roadside protection. A Texas statute permits the State to obtain 100 feet for a State highway, which ordinarily is ample.

The minimum standard widths of the various states on new locations vary from 80 to 100 feet for main trunk highways, and from 60 to 80 feet for county or secondary roads, with widths varying from 100 to 200 feet for super-highways. These adopted minimum standard widths appear adequate for present or future traffic requirements, except near a few industrial sections which have an enormous traffic over short stretches. Several states have already adopted the plan of widening the right-of-way at railroad crossings and road intersections. The methods of acquiring right-of-way are rather varied and include the following:

1. County or municipality acquire the right-of-way at no expense to the state.
2. Purchase by the state, payment being based on assessed valuation.
3. Purchase by the state by agreement or condemnation suit.

Safety, Ease, and Economy of Travel. In classifying highway accidents, there are mainly three contributing factors, as follows:

(1) Incidental to the driver himself, such as bad vision, drowsiness, dull sense, over-strain, excessive speed, general disregard for traffic rules, etc.

(2) Defects in the automobile, such as bad brakes, bad headlights, broken parts, etc.

(3) Improper location, construction or maintenance of the highway, such as sharp curves, steep grades, slippery surfaces, high crowns, narrow pavements or shoulders, steep ditch slopes,

narrow bridges, holes in the surface, lack of super-elevation, railroad grade crossing, etc.

The third class of accident is primarily a problem for the highway engineer. The behavior of the motorist cannot be regulated to any great degree, but the highway can be put in a condition which will help reduce the serious loss of life and property now occurring daily throughout the country.

Sharp curves must be flattened, steep grades reduced and ample sight distance provided at all points in order to render the highway reasonably safe for the swift traffic of today. If a long stretch of easy alignment, where fast speed is normally invited, breaks abruptly into country where sharp curves are inevitable, the hazard is great, and much expense is justified in designing for a more gradual increase of curvature.

Considerable safety can be added on side-hill locations by cutting back the slope around curves, leaving them about 4 ft. high over which the driver can see approaching cars; the remaining bank keeps him on the original alignment.

Bad alignment and narrow bridges are both dangerous hazards that should be avoided. Bad grades and lines are more definitely localized and noticeable at bridges than elsewhere. The effect is made more acute by the fact that most bridges are narrower than the roadbed. As the width of bridges, California practice is to use multiples of traffic lanes 10 ft. wide plus 2 ft. on each side, the additional 2 ft. being omitted where there is a sidewalk. The widths are thus 24 ft., 34 ft., 44 ft., etc., except where special conditions require other widths.

The Association of State Highway Officials recommends for safety 10 feet of width for each traffic lane and a shoulder width of 8 feet. The minimum requirement for width of right-of-way in California is 80 feet.

Ample guard-rail protection on high fills is very desirable.

Standardization as to construction features and traffic regulations should be uniform in character.

The construction of "by-pass" routes to carry through traffic around congested cities rather than through business sections is a feature of highway work which promotes not only safety, but convenience of traffic. In suburban areas, where there is considerable pedestrian traffic on highways, it is highly desirable to provide footpaths back of the ditch lines. All highway bridges in such areas should include sidewalks. The construction of pedestrian tunnels underneath heavily traveled roads is an important safety measure, particularly in the vicinity of school houses.

Rolling grades may be justified for reasons of economy of construction and often they produce no appreciable economic loss in operation. Their objectionable feature lies in hazards at vertical curves and in roadway appearance.

In order to avoid the tendency of encroaching on the wrong side of the road and trying to make a left turn on the inside of the curve, the road must be superelevated and transition spirals should be used.

Drainage. It is desirable to avoid locations which encounter unstable foundations, such as swamps and soft ground, where construction is expensive and drainage difficult. All points of the road should be above the level of flood water.

Railroad Grade Separations. Grade separations at railroad intersections are highly desirable. In situations where grade crossings must be tolerated as a temporary measure, on account of insufficient funds, the line should be located so that future separation can be developed, and in all cases approach curves and grades should not restrict sight distances.

Grade separation projects will be one of three types as follows:

Overhead (highway carried over railroad), *subway* (highway carried under railroad), and *relocation* (the location of the highway changed so as to avoid crossing the railroad tracks). Frequently, a thorough study of the territory will disclose the fact that it is feasible to eliminate one or more crossings. Aside from this last class, the use of the overheard or subway type may involve a relocation of the highway so as to effect a practical crossing.

If the road goes *under* a railroad, the clear distance from bottom of overhead structure to crown surface of roadway should be at least 14 feet; if it goes *over* a railroad, the minimum clear opening vertically above the top of rail should be 22 feet.

All plans for under—or overhead crossings must be approved by representatives of both the highway department and the railroad company—and usually the project is financed on a 50-50 basis.

In cases where grade crossings must be tolerated, the approaches thereto should be made as easy as possible; and the entire intersection should be designed with due regard to all possible safety regulations.

Intersecting Roads. On intersecting major highways, grade separations are desirable. Under or over-passes should be provided with suitable ramps constructed as feeders from one highway to the other.

On super-highways or boulevards carrying as many as 50,000 vehicles per day, there should be no railroad or highway grade crossings, draw bridges, or anything which would interrupt the

flow of traffic at any time. All crossings would be either over or under the main road and all entrances and exits in the direction of traffic.

Visibility. Along with considerations of alignment and grade, visibility or sight distance should be a controlling factor.

Every condition of the highway, whether an intersection, a railroad crossing or anything that requires the driver's attention, should be seen far enough ahead to enable him to take appropriate action. The sight distance along the highway is governed by the prevailing speed of traffic at the particular location. Still greater speed limits will probably be allowed in the future, and the engineer should plan his location to meet this condition. A sight distance of 600 feet on horizontal and vertical curves is not excessive. In case a sufficient distance cannot be obtained, extra width of surfacing is desirable; or under some circumstances, the roadway may be separated into one-way roads, thus permitting the required sight distance to be in half. City conditions do not require more than 300 feet of sight distance.

The Ultimate Plan. A splendid mode of procedure for all cases is to adopt a policy that a major location plan be worked out for future improvement, and that this be utilized on individual sections as the opportunity arises. Proceeding in this way, the ultimate plan, when finally completed, may be considered a permanent improvement.

Climatic Conditions; Snow Control. In regions subject to heavy snowfall, the highway should be located with reference to preventing or reducing snow drifting. Quoting Mr. H. K. Bishop of the Bureau of Public Roads, the following procedure will tend to attain this result:

"Northern slopes should be avoided; in open areas the highway should follow ridges where possible or should be placed on slopes against the prevailing winds; long shallow cuts should be avoided, but where this is impracticable the location and construction should be such that they will not cause drifting; in flat country, drifting is reduced by elevating the grade 2 or 3 feet above the surrounding land and with the construction of 1 on 4 slopes; in mountainous or sparsely settled areas where winter traffic is not sufficient to justify the expense of keeping the roads open during the entire winter, proper exposure is highly essential in order that the snow may melt and free the road for traffic as early in the spring as possible.

In the plains country fine dry snow carried by a winter gale will drift into every cut and depression. Until the snow has settled and partly packed, it is difficult to keep an east and west road open.

Aesthetic Considerations. The general appearance of any highway, whether pleasing or displeasing, depends upon the design of the road itself as well as the treatment of the roadside areas.

Straight lines and graceful curves are pleasing to the eye; while the reverse is true of broken lines, unsightly kinks, or ill-fitting curves. It has been suggested that a location containing, within one view, three tangents and two curves, or two complete changes of direction, whether horizontal or vertical, is not pleasing. Transition spirals improve the appearance of horizontal curves, aside from adding to the ease and safety of travel.

Bridges and other structures along the right-of-way when designed with attractive architectural proportions may be made an ornament to the highway.

More attention should be given to roadside beautification and scenic effects. Unsightly objects should be removed. Large and rare trees and shrubs found in their natural state on the right-of-way should be preserved. Along barren stretches of the road, trees should be planted.

Until such time as adequate legislation is enacted placing roadside development under the supervision of highway authorities, the engineer should use such means as are available to protect and preserve the highway for its complete utilization. To this end, Mr. A. R. Losh offers five suggestions:

(1) Acquire sufficient right of way for future development of the highway.

(2) Obtain extra widths at all road intersections and other strategic points where it is likely that roadside enterprises would be established.

(3) In making acquisitions it will usually be possible to retain in the right of way the narrow strips, gores, and other parcels of land cut off from the original tract. These parcels may be utilized for highway purposes in the future or for roadside planting and beautification. In any event they are not available as sites for billboards and roadside establishments.

(4) Through areas of natural beauty, either obtain in fee or protect with long-term leases, several hundred feet extra width on each side of the right of way.

(5) The interest of civic organizations and public-spirited citizens should be encouraged and their aid secured to obtain the desired ends.

EDITOR'S NOTE: T. F. Hickerson, Member of A. S. C. E. and Professor of Civil Engineering at the University of North Carolina, is a recognized authority on highway curves and earth work. The above article is an abstract from his new book on *Highway Curves.*

APPLICATION OF RADIO TO AIRCRAFT OPERATIONS

(Continued from page four)

radio phone signals or broadcast on the same wave length; whereas other beams are switched off at half hour intervals and weather reports broadcast. Thus a plane need only have a small radio set for receiving both beams and communication.

Radio manufacturers now make light and efficient sets that enable any plane owner to take full advantage of the weather and beacon service provided by the Department of Commerce and privately owned stations of aviation transport companies. No radio experience is necessary to operate these sets, and they are as simple in construction as an ordinary broadcast receiving set. The reception of beacon signals is only the first step. With a two-way radio telephone system the ship is also in constant touch with the ground force. The Department of Commerce ground stations do not hold two-way communication with planes flying near them except in an emergency, but they do broadcast weather reports and other flying information constantly. It can easily be seen that it would be practically impossible for these stations to carry on conversations relating to position reports, traffic, etc., and at the same time fulfill their function of broadcasting weather reports. In order to allow private planes hold two-way communication and receive special instructions, the Federal Radio Commission now lets any airport use a low power, short-wave transmitter having a range of ten to twenty miles. The planes also carry short-wave transmitters.

With the radio system a new airplane operating procedure is possible. Instead of being isolated from the moment he leaves the ground, the pilot is now in direct telephonic communication with all of the major airports along his course and with other planes in his vicinity. As he flies his course by the beacon he is periodically advised about wind velocities at various altitudes and changes in weather. He may be advised to fly another route to avoid a storm area that is unknown to him. If for some reason he lands at an isolated field, he can tell the ground crew of his position immediately. The exchanging of weather reports between planes is regarded as very valuable.

Airport operators will find radio in the future a great help in directing traffic. At the present time traffic control on large airports is handled by the waving of a flag or the blowing of a whistle. When two-way radio communication comes into general use the field manager can give verbal instructions to the pilots taking off or landing.

Future developments in radio will undoubtedly increase the reliability of air travel. An accurate radio altimeter will probably be developed. Television will bring the planes in closer contact with the ground crew. Freight planes will be piloted by radio. It is impossible to try to enumerate all of the future developments, but they are coming and will bring a higher degree of safety.

THE NEW WIND TUNNEL IN THE MECHANICAL ENGINEERING LABORATORY

(Continued from page nine)

mass is rotated about a center there is a force set up on the body, tending to pull it away from the center. The magnitude of this force is proportional to the square of the angular velocity. In a liquid tachometer the rotating mass is a body of oil which is made to rotate in a closed cylinder, proportional to the speed of rotation of the machine to which it is attached. When the oil rotates it sets up a pressure in a radial direction against the wall of the surrounding cylinder, which is proportional to the square of the rotating speed. By tapping a hole through the cylinder wall in the radial direction and connecting this to a vertical glass tube, the oil will rise in the glass tube till its weight balances the pressure in the cylinder. Therefore, by calibrating the tube, the speed of the blower can be read at any time. This type of tachometer has proven satisfactory in every respect.

Perhaps the most difficult part of the tunnel and its accessories to design and construct was a satisfactory balance for measuring forces acting on an airfoil being tested. This balance had to be so made that it could hold the model in place and measure the drag force and the lift force at the same time as well as the torque which tends to twirl the model about its transverse axis. There also had to be an arrangement for measuring the angle of attack of the model being tested. Such a balance has been designed and built in the laboratory shop so that it fulfills all these requirements satisfactorily and still is easily operated.

The tunnel and its accessories, although built at an actual money cost of about $200, is valued at $1000; and, although it is still in the throes of calibration and adjustment, it is already playing a major part in the instructing of the students of aeronautical engineering in the methods of obtaining test data for use in airplane design and development.

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THE CAROLINA ENGINEER

UNIVERSITY OF NORTH CAROLINA

CHAPEL HILL, N. C.

G. W. GORHAM, JR.
EDITOR

F. S. BLACK
BUSINESS MANAGER

March 1, 1933

To the Alumni of the University of North Carolina—

Dear Sirs:

This letter is addressed to you in an effort to secure your interest in a magazine that we hope will eventually prove a great asset to the Engineering School of the University.

Copies are being sent to as many of the engineering alumni as possible in order that they may see the attempt that is being made to publish something that will be of interest and assistance to all those connected with this branch of the institution and something that will be a step toward future advancement.

At present the magazine is used as a method of developing additional interest in the engineering students in engineering subjects both through reading and making contributions themselves. The articles of this issue should show the enthusiasm with which the students are entering into the work and also the advancements that are constantly being made in the other activities. In the future, we hope to develop communication between the Engineering School and its alumni by the addition of general news columns and also by printing articles sent in by the alumni. This phase of the work, however, cannot be carried out until the magazine has established itself through its inherent qualities and some form of financial background.

It is therefore evident that we would like very much for the subscription list of the "Carolina Engineer" to contain as many of you as possible.

Yours very truly,

G. W. GORHAM, JR., *Editor*

F. S. BLACK, *Business Mgr.*

WORKS OF ART

ALL WORKS of art are not found in the Art Galleries, Studios and Libraries. The art of creation is not confined to paintings, sculpture and literature. Any work on which the craftsman has put the thought, patience and skill that produces a thing of real beauty, originality and the nearest approach to perfection of which man is capable, is a work of art.

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